metric logarithms is one which shows clearly the dual use of the tables for reading off the logarithmic sines of angles and the logarithmic cosines of their complements. With small books of tables this is best done by using the right-hand column and top line for logarithmic sines, the left-hand column and bottom line for logarithmic cosines. This is the arrangement adopted by Dr. Briggs in his " Clive's Mathematical Tables." The same arrangement is followed in regard to tangents and co-tangents. The tables of secants and cosecants are another desirable feature. By adding the logarithm of a cosecant instead of subtracting the logarithm of a sine, many compound expressions may be calculated by a single addition sum. It is a pity that logarithms of reciprocals are not also given. The tables are given to five places, and corrections are given in all of them where the differences are irregular. The explanatory matter is very useful to students, notably the definition of significant figures.

Dr. Denning, in his introduction, remarks that " Criticisms and suggestions for future editions will be welcomed." The first criticism which suggests itself is that a book where logarithms of numbers less than four *have necessarily* to be taken from a table of antilogarithms, and logarithms of numbers greater than four from a table of logarithms, is far too ingenious to put into the hands of a beginner. The object of this arrangement is, of course, to avoid the large and irregular differences that occur with logarithms of the lower numbers and antilogarithms of the higher ones. If the book is *not* meant for beginners the arrangement is good, but for teaching the use of tables the complete tables of logs. and antilogs. should be given, and students should be taught later on when to use each. The insertion of corresponding tables for obtaining logarithms of reciprocals is a good feature. It seems rather curious that no one has adopted the plan of bordering a table of antilogarithms with a bottom line and right-hand column containing the arithmetical complements of the numbers in the top line and left-hand column. Such an antilogarithm table would give logarithms of reciprocals very simply.

The arrangement of the trigonometrical tables is not very clear. There are no head- or footlines to the middle page, and while the columns look to run on from one page to the next, they do not really do so. The left-hand column of the first two pages goes from 0° to 15°, and we naturally expect to find 15° to 30° on the next page, but instead of that we find 30° to 45°, the entries for 15° to 30° being on the right-hand column of the first two pages. The misprint " co-functions " at the foot of p. 16 does not really introduce additional confusion. The book contains tables of squares and cubes for those who like to indulge in such luxuries. Pages of physical and chemical constants, electric units and data, together with some of the differentiation and integration formulæ also given, are really useful, and, finally, some " simpler mechanical relationships " and statements of the binomial and Maclaurin's theorems would be of greater value to the average student if

they bore the heading " Things that Ought Not to be Learnt."

These criticisms do not preclude us from stating that the tables will be very useful to such science students as have learnt to find their way about in them.

GEOGRAPHY AS A LIVING SCIENCE.

Beobachtung als Grundlage der Geographie. By Prof. Albrecht **Penck**. Pp. 63. (Berlin : Gebrüder Borntraeger, 1906.) Price 1.60 marks.

THIS little work, which is choicely printed, is a record of a delightful personality. It contains the parting address of Prof. Penck to the students of Vienna, and his introduction to those of Berlin, now the suzerain-city of the land where he was born. The first words, " Liebe Freunde," ring very truly in our ears, and the title of the pamphlet recalls to those friends scenes in very many lands. Especially prized by the present writer is a little photograph—a mere imperfect sketch, if you will—in which Prof. Penck is seen writing up his notes in the open air, on the very edge of one of the world's great landscapes, where the scarp of the African tableland goes suddenly down towards the sea. Like his distinguished botanical colleague, Prof. Engler, Penck has realised the tradition of Humboldt, and has felt that the German people " darf sich in geographischer Arbeit nicht auf sein Gebiet beschränken, es muss solche auf der ganzen Erde leisten " (p. 60).

The striking contrast of geographical position makes it necessary to urge the claims of travel more strongly in Berlin than in Vienna. The romance of Vindobona and Carnuntum, of the Germanised city facing the great " Kessel, in den sich Völkerwoge auf Völkerwoge stürzte," calls us eastward in the first few pages, and we ask ourselves, What has Berlin to offer after this? In the last pages, however, we meet our answer—Germany centres in the flat land of Berlin, but Germany has spread her wings. Near the North Pole lies King William Land, near the South Pole lies Emperor William II. Land, and the union of the German States has allowed all Germany to look towards the sea. On this medium, which no longer divides but joins the continents, we trust that ships may bear in all directions the students of Berlin, imbued as they cannot fail to be with the high and genial spirit of their master.

In the Austrian section of the pamphlet, Prof. Penck shows how tectonic geography has specially developed in Vienna. He urges, however, that the relations between internal structure and surface-features are not always so close as has been supposed. The forms associated with the higher regions of the Alps are thus due less to the recent folding of the chain than to the surface-action of the glaciers of the Ice age and of modern times (p. 16), which continuously carry away, by a nibbling action, fragments from the valley-walls. The author believes that the Alps were far more rounded before the advent of the Ice age, though they possessed (p. 20) a much

dissected Flysch-zone, and that the contrast between the surface of the young folded chain and that of the old " Rumpf " of Bohemia is in reality a development of fairly recent times. The Alps, moreover (p. 18), appear to have gained in height, by a vertical movement, since the formation of the interglacial lakes, and thus their present preeminence is not to be ascribed to lateral thrust alone.

The uniformity of level of peaks in the same district is then discussed, and it is argued that the cutting of valleys in a mass undergoing denudation influences the heights of the peaks along the valley-walls. After a long time, where the hardnesses of the rocks concerned do not greatly vary, the upstanding points at any given distance from the centre of the chain will tend to be reduced to much the same level above the sea, and the impression given will be that they were originally points on a continuous dome. It is clear that the author here asks us to be cautious in applying the fascinating doctrine of the " peneplain " and of subsequent elevation to every dissected highland.

The consideration of the post-Pliocene uplift leads us on to the vigorous and partly post-Roman depression of the Adriatic region, with the compensating elevation of the Apennines; then follows a survey of river-courses in central Europe. The movement of masses of land in vertical blocks, to which geomorphological studies in the Alps have directed attention (p. 36), is shown not to be inconsistent with horizontal movements, and with folding, where one block rides over another (p. 34). The relative importance of vertical movement and horizontal thrusting, and how far the one may be a manifestation of the other, are left as problems for the future.

So far, the results of recent observation, geographical it may be, but with a remarkably geological trend, have been summarised for the region of which Vienna is the natural centre. A few words in praise of observational research conclude this section. The title of the pamphlet is, however, really justified in the discourse to the students of Berlin, which opens with a somewhat depressing picture of their natural environment. Men, not mountains, have made the greatness of the geographical school of northern Germany. Prof. Penck contrasts the influence of Karl Ritter, who regarded the earth from the point of view of its suitability for man, with the later and more scientific attitude of von Richthofen. In each case the geographical outlook depended on the stage reached contemporaneously in the development of scientific thought. Ritter expressed (p. 47) the teleological views of his time; Richthofen " nimmt die Erdoberfläche nicht als gegeben, sondern als geworden, naturgemäss daher bei ihm die enge Fühlung zwischen Geographie und Geologie." Followers of Richthofen should insist on being observers, not mere critics and coordinators. Modern means of communication have made travel a matter of money only, instead of both time and money, as in bygone years. The small scale of the maps of the more recently explored countries masks the immense amount of

work that is waiting to be done, and the district adjacent to a colonial railway station may well reward the student who goes out skilled in observation. With such stimulating words Prof. Penck enters on his new province in Berlin, and he may be sure that his friends in the four corners of the world will welcome those whom he has trained.

GRENVILLE A. J. COLE.

THE STRENGTH OF MATERIALS.

Text-book on the Strength of Materials. By S. E. Slocum and E. L. Hancock. Pp. xii + 314. (Boston and London : Ginn and Co., n.d.) Price 12s. 6d.

THIS book is intended to provide for the needs of engineering students both in the class-room and in the laboratory; hence it is divided into two parts, the first part treating of the theoretical side of the subject and the second dealing with the experimental side. The first two chapters are devoted to a general discussion of the relations between stress and strain as an introduction to the development of the more special rules applicable to the structural forms in common use by engineers and architects. There is an unfortunate slip on p. 10 in the paragraph dealing with the fatigue of metals; in quoting some of the results obtained by Bauschinger in his experiments, the material is stated to have been " cast iron "—it was, of course, " wrought iron." Chapters iii. and iv. deal with stresses and strains in beams, and there are two useful constructions not usually found in text-books on this subject, namely, a graphical method of finding the centre of gravity and the moment of inertia for a rail, or other similar section, and a graphical solution of the problem of finding the moment of inertia of a reinforced concrete beam of rectangular cross-section.

In dealing with the flexure of beams in chapter iv., the problem of continuous beams is fully discussed, and, in addition to the method of three moments, other methods of solution of the problem, based on Maxwell's theorem and on Castigliano's theorem, are explained.

In the next two chapters the design of struts and shafts is dealt with, also the theorem of helical springs, but there is nothing novel in the treatment of any of the problems which have to be solved.

In the chapter which treats of the strength of spheres and cylinders under uniform pressure, a neat formula is obtained for the critical pressure just preceding collapse in the case of a hollow circular cylinder subjected to external pressure, and Lamé's formula for thick cylinders is deduced.

Two subjects—flat plates and hooks—which in most of the text-books are usually treated in a somewhat unsatisfactory fashion are thoroughly investigated in chapters viii. and ix.; in the case of crane hooks it is pointed out that the ordinary assumption that the distribution of stress is the same as in a straight beam subjected to an equal bending moment and axial load is not even approximately correct. From an analysis of the stresses in a curved piece subject to pure bending strain, a general formula for